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OVER VOLTAGE AND UNDER VOLTAGE PROTECTION SYSTEM WITH PHASE SEQUENCE CHECKING USING AUTO TRANSFER SWITCH (ATS)

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Keywords: *Load, main line ,overvoltage and under voltage, phase angle, trip, phase sequence, magnetic contactors, relay.*

ABSTRACT
Electrical And Electronic components can get damaged due to any kind of voltage or current malfunction. In electrical connection, voltage transients contain a high risk of destroying any electronic device. The point of this project is to build multifunctional protection device which can recognize any kind of disturbance in the path from the main line to the load and switch the power source automatically within a short range of time
If the error in the transmission system is acknowledged, the proper authority can take steps to fix it and it would nullify the risk of operating devices. The proposed device will monitor the continuous flow of voltage from the main supply and if the main supply has fluctuations such as overvoltage and under voltage occurs, phase angle is changed from the requirement, the device will trip and shut off the distribution.. A set of relays and magnetic contactors has been used here for tripping. The voltage, phase sequence and load side ratings are determined by the user authority. A short time delay is used to avoid fluctuation and get a stable supply. This idea can be stretched out in future by accommodating more features creating more focus on speed, reliability, security and sensitivity. Giving the maximum protection is the only motive of building this device.

INTRODUCTION
The quality and the service provided by our instruments depend on the fact on how well it is maintained and protected. Proper protection against instabilities of the system is a necessary issue when we are connecting a device, especially if the device is expensive, to avoid unnecessary financial losses and interruptions in the system. [1] The main objective of this project is to design a device that provides multiple protections at once by collaborating different circuits that has different features together to work as one particular circuit.

The project we designed is a automatic switching system that will give protection against the transients in the main supply and also to ensure overload protection. This will be done by designing the auto transfer switch first and the other circuits are connected accordingly. The overvoltage under voltage and phase checker circuits are designed and implemented separately and added into the auto transfer switch. The overvoltage and under voltage circuit detects the voltage transients in the main supply and disconnects the circuit if abnormal behavior is detected. The phase sequence checker checks the phase of the main supply and trips if the correct phase sequence is not detected. The overload circuit is connected to the output of the auto transfer switch which maintains the fact that the load does not exceed its predetermined limit.

These abnormalities therefore will be avoided by the protection of the project we designed which otherwise can cause severe damages like reverse rotation of motor, overheating ,reduction of equipment life and can even cause a fire which is also a safety issue for the operators. [2]

PROJECT DESCRIPTION
The basic function of this project is to detect voltage abnormalities in the main supply line and breaking and switching the load from the main supply to a backup source like a generator. These abnormalities are detected by the overvoltage and under voltage protection circuit and the phase sequence relay. These constructed circuits are connected in the switching system, so they collaborate according to our specified project. Timer circuits are added into the system, for safe and accurate transfer of voltage.

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A. Circuit Diagram

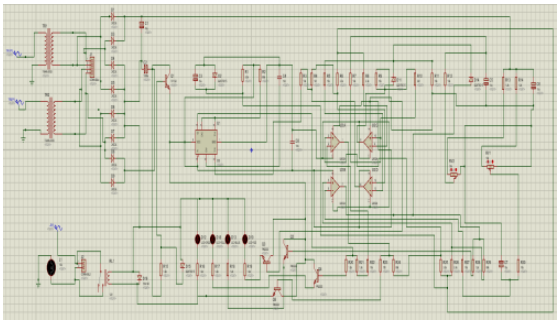

Figure 1: Overvoltage and under voltage protection

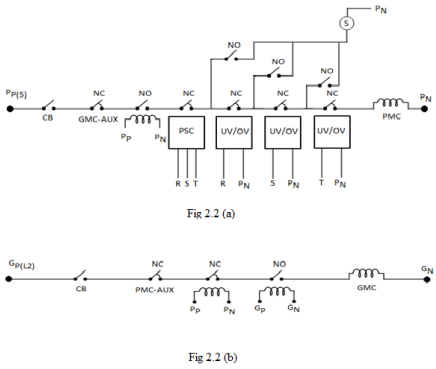

Figure 2: Mechanism of the ATS

B. Block Diagram

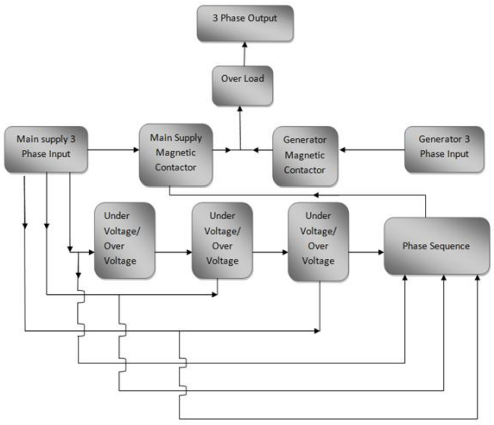

Figure 3: Block Diagram of The System

The Figure 3 shown above is a sample block diagram of our project. It illustrates how an automatic transfer switch works in actual and can transfer power between the sources when needed. The main three phase supply is connected with the load through the magnetic contactor in normal times. But in case of any faults detected in the utility supply or power in the main supply this system switches into any alternative sources connected. A three phase generator is used as the alternative power source in our project. The fault protection scheme for the loads includes under voltage overvoltage protection and phase sequence protection. As we can see in the block diagram, all the three phases have to pass through the protection circuits individually and if they maintain proper supply voltage and remain in correct phase sequence only then the power can step forward. And only if any fault found by these four protection block or the main power supply is unavailable then the switching occurs and power flows from the generator to the load.

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C. Hardware Implementation

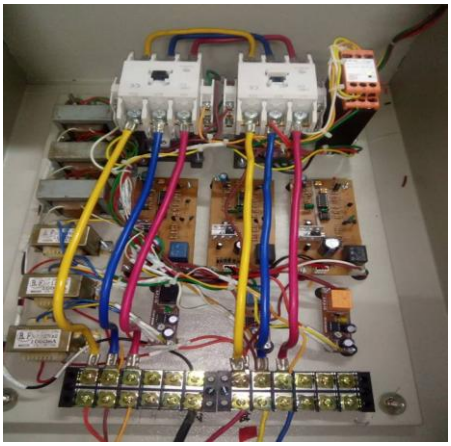

Figure 4: Full hardware implementation of the ATS with the protections

The Figure 4 shows the designed implementation of the full system.

D. Simulation

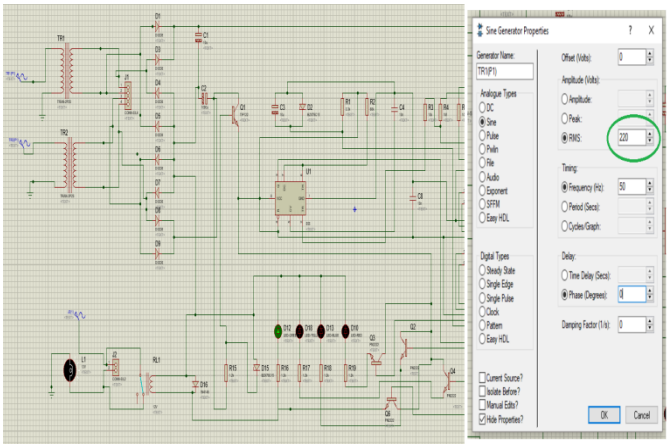

Figure 5: Normal operating condition of the OV/UV circuit

When in normal operating condition with an input supply of 220V there is no interface from PDB to load power flow. A green LED indicates that the input supply is in an acceptable range. Therefore the relay remains in closed position.

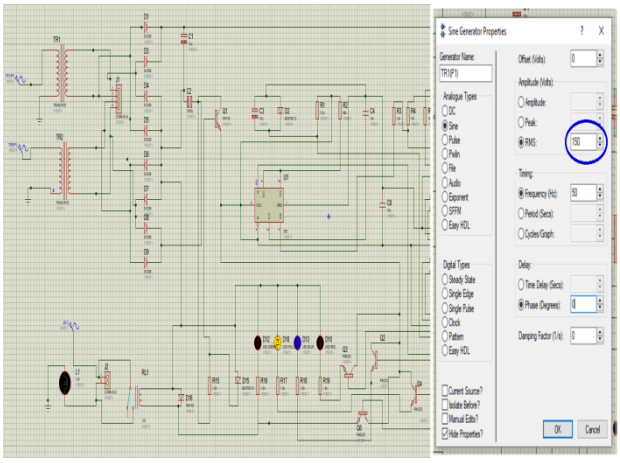

Figure 6: Under voltage condition of the OV/ UV circuit

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With an input supply of 150V the power flow from PDB to load should interrupted as it falls below the minimum acceptable voltage. That is why the blue LED turns on and indicates that the input supply is in under voltage condition. Therefore the relay switches from closed to open and power flow is interrupted.

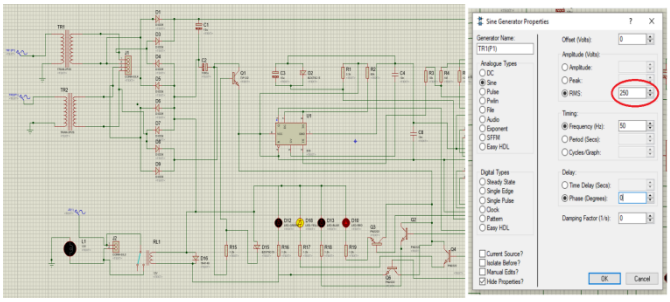

Figure 7: Over voltage condition of the OV/UV circuit

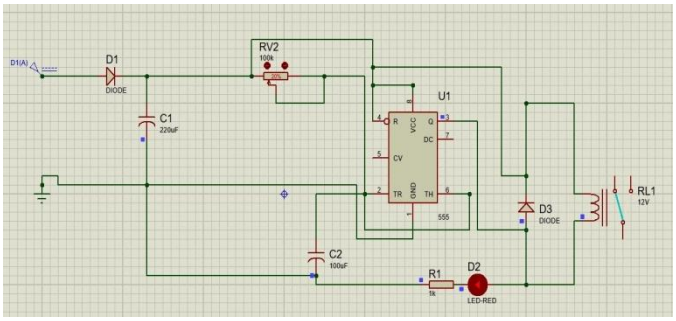

Figure 8: Timer circuit diagram

A delay timer relay and a regular relay works the same way but a delay timer can add a time delay before the switching. This delay can be varied depending on circuit purpose. A 555 timer IC does the job. The time for switching in a 555 timer uses this equation to operate: T=1.21 RC and lets the relay coil energize after the desired delay.

E. Results

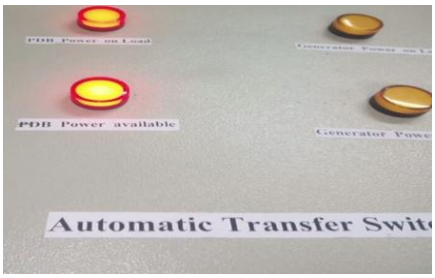

Figure 9:RED LED indicating PDB power Available / On load

Figure 10: YELLOW LED indicating Generator Power Available / on load

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DISCUSSION AND SUGGESTION FOR FUTURE WORK

The main purpose of this project "Overvoltage and under voltage protection system with phase checker sequence using Auto transfer switch" is to develop a automatic switching system that has multiple protections designed into it. The switching system was mainly composed of magnetic contactors, connected in a specified way to make the system automatic. Voltage fluctuations are very common but can cause severe damage to loads connected. For this project we used magnetic contactors, phase sequence checker, comparators and different combinational logics. Few problems were faced during the implementations. Voltage abnormalities in the main input supply will be detected by the protection circuits , the overvoltage and under voltage protection and the phase sequence checker. . The protection systems will trip the main supply connection to the load and the system will switch automatically. The switching is the operation of the ATS

This project is very necessary equipment for any for anyone dealing with three phases or even a single phase mains supply. It has wide range of opportunities for further modifications and development. After proper design and modification this project can be used commercially in our country. Voltage fluctuations can occur any time and cause unnecessary financial losses to our system. It is very important for any organization that deals with expensive loads to ensure proper protection and operation of the system. This project can be used for such purposes to minimize losses and to maximize efficiency and protection. . The system can be improve by introducing a GSM based system and android application can be developed and connected to several ATS installed to different loads . This can help to monitor multiple systems very easily. As the device is made for transferring switches with highly protecting features it has more development in future. These developments are needed to make this project unique and more accurate in future. Though this project has some limitations, some progress can be made in this project by making the following development.

The standard expectation of an automatic transfer switch in regards to a continuous load is that the switch should be able to hold maximum value for three hours or more. Transfer switches differ widely from other emergency equipment in that they must continuously carry the current to critical loads, either from the normal source of power or emergency source. Whereas, a standby engine generator set usually supplies power only during emergency periods. Automatic transfer switches for diesel generators are manufactured to meet continuous current ratings of 30-4000 amperes. Modern transfer switch technology is capable of carrying 100% of the rated current at an ambient temperature of 40° C. Transfer switches incorporating integral over current protective devices may be limited-to a continuous load current no more than 80% of the switch rating. In modern switches there are control measures in place to make sure no more than 80% of the load is continuous. However in older units system failure is a possibility for exceeding 80%. Project engineers should anticipate future load requirements during the planning process. Not all projects require forethought into future load requirements however it is generally advisable to select a transfer switch with a continuous current rating equal to the total of the anticipated load.

CONCLUSION

The project has been developed by integrating features of all the hardware components discussed thoroughly in a previous chapter. Secondly, the necessity of every hardware component have been reasoned out and implemented carefully to get the best effectiveness of the whole unit as one. The devices were used as the design of our system requires us to, to achieve successful results. Voltage abnormality in electric power supply can have critical effects on the connected loads and cause unnecessary losses in the system. Therefore it is very important to detect these abnormalities and avoid these unnecessary losses and accidents by ensuring safe power transfer and switching into our loads.

It also minimized the difficulties of the engineers in maintenance since the whole system is completely automatic. Finally, it can be come to a conclusion that the ATS with several protection schemes is an important field for research and development. Studies are undergoing on how to increase the efficiency of the project .There have been many more suggestion for this project also. Some limitation should be maintained for this project that the project can run successfully. The balancing of the component and error detecting was completely done.

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